Research and Development Program 2.6

SCIENCE AND TECHNOLOGY PROGRAM

FISCAL YEAR 1998

"Building the Ultimate Smart Weapon:
The American Soldier"

U.S. ARMY RESEARCH INSTITUTE

October 1997

The mission of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is to conduct personnel performance and training research in support of Army goals. The purpose of this document is to describe the work that ARI will accomplish in its Fiscal Year 1998 Applied Research (6.2) and Advanced Technology Development (6.3) programs.

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     Lieutenant General, GS
     Deputy Chief of Staff for Personnel

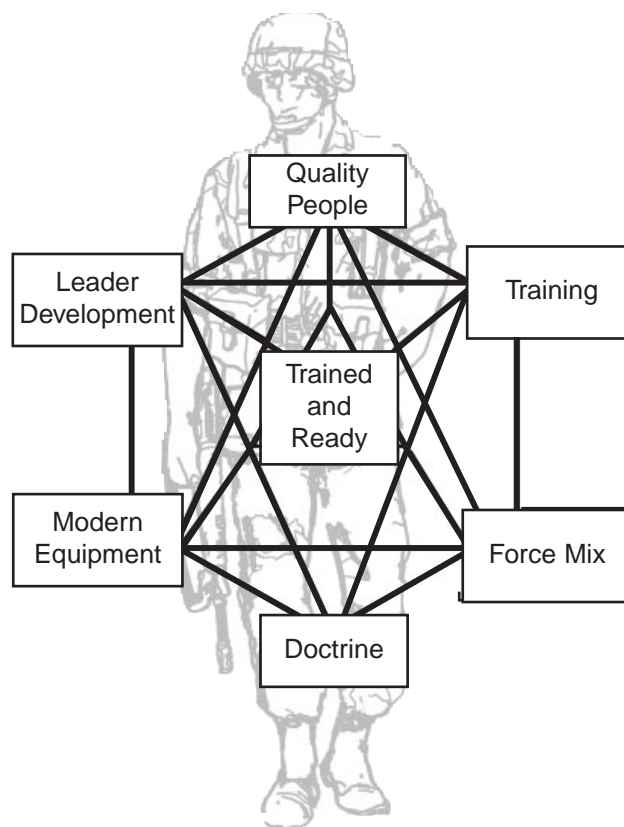*For additional information about this document, you can reach ARI at:*

If you have questions about specific projects in this document, please feel free to contact the individual Points of Contact at the end of each project description.

U.S. Army Research Institute's
SCIENCE AND TECHNOLOGY PROGRAM
FISCAL YEAR 1998

"Building the Ultimate Smart Weapon: The American Soldier"

The U. S. Army Research Institute's Science and Technology Program For Fiscal Year 1998
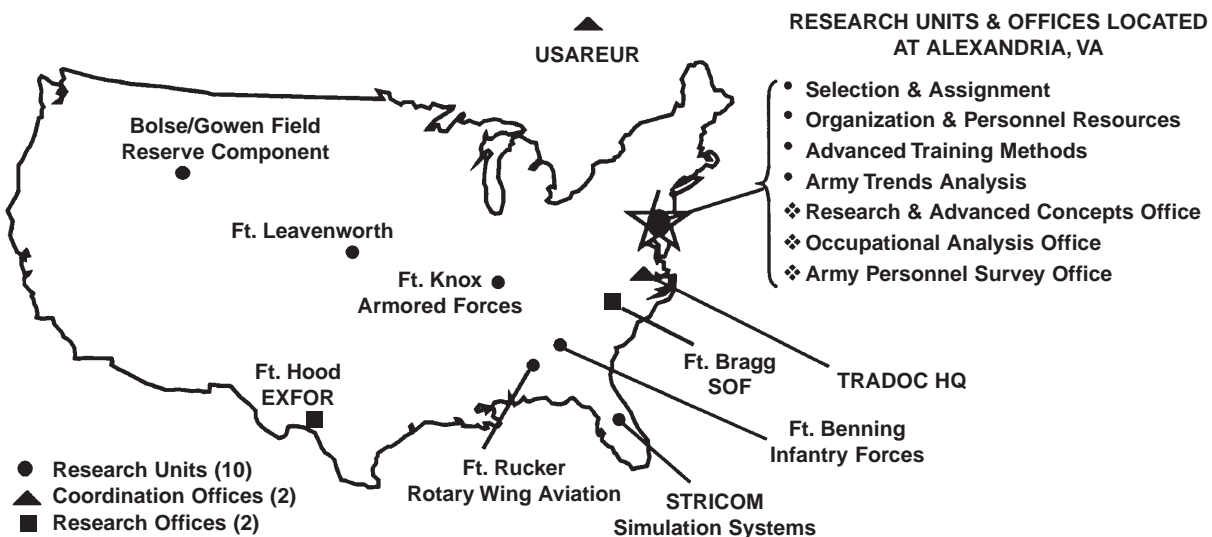
This document describes the U.S. Army Research Institute for the Behavioral and Social Sciences' (ARI) Science & Technology (S&T) Research Program for Fiscal Year 1998 (FY98), and provides an overview of the Institute's mission and goals. The 15 work packages described cover the Applied Research (6.2) and Advanced Technology Development (6.3) planned for FY98.

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is the Army's primary laboratory conducting research on personnel performance and training. Our main focus is on the human element in the Army — *the Soldier*. Our research contributes to improving the entire life cycle of the soldier: recruiting, selection, assignment, training, leader development, and mission performance. It also includes programs to improve quality of life for soldiers and their families. ARI's mission is to provide new technology to meet the personnel and training challenges of the

Army; conduct studies and analyses to address short-term issues and respond to "hot topics" that emerge; and provide technical assistance on critical issues affecting all parts of the Army — the organization, the people, and the technologies for the future.

To accomplish our mission, ARI is located at key Army installations shown on the map below. ARI has ten Research Units and two Research Offices that execute our Science & Technology (S&T) research program — Applied Research (6.2) and Advanced Technology Development (6.3) - described in this document. We also have the Research and Advanced Concepts Office (RACO) that manages our Basic Research (6.1) program which is focused on personnel performance and training issues of the future, and is primarily University-based.

In addition, ARI has two offices that provide operational support and two that provide coordination and liaison: (1) the Army Personnel Survey Office (APSO), that develops and fields Army-wide surveys and provides expertise on personnel survey development and methodology to other Army and DoD Agencies; (2) the

USAREUR

Bolse/Gowen Field
Reserve Component

Ft. Leavenworth

Ft. Knox
Armored Forces

Ft. Hood
EXFOR

Ft. Bragg
SOF

Ft. Benning
Infantry Forces

Ft. Rucker
Rotary Wing Aviation

STRICOM
Simulation Systems

TRADOC HQ

RESEARCH UNITS & OFFICES LOCATED AT ALEXANDRIA, VA

- Selection & Assignment
- Organization & Personnel Resources
- Advanced Training Methods
- Army Trends Analysis
- ❖ Research & Advanced Concepts Office
- ❖ Occupational Analysis Office
- ❖ Army Personnel Survey Office

● Research Units (10)
▲ Coordination Offices (2)
■ Research Offices (2)

"Building the Ultimate Smart Weapon: The American Soldier"

Occupational Analysis Office (OAO), that develops analytical tools and methods and conducts very complex Army-wide occupational/job surveys and analyses; (3) the coordination office providing liaison to the Training & Doctrine Command (TRADOC); and (4) the coordination office providing liaison to the U.S. Army in Europe (USAREUR).

To be trained and ready to meet today's challenges and the ever-changing requirements of the digitized battlefield for Force XXI; and to become an effective, quick-reaction, mobile fighting force as the Army After Next (AAN), the Army must maintain a proper balance among its six imperatives: (1) quality people, (2) leader development, (3) training, (4) doctrine, (5) force mix, and (6) modern equipment. ARI's S&T program supports these Army imperatives, focusing on Force XXI and AAN changes. Specifically, our research addresses **quality people, leader development,** and **training**.

The purpose of this document is to describe the work to be accomplished through our 15 applied research and advanced technology development work packages related to quality people and training that make up our FY98 S&T program. Leader development efforts in FY98 are concentrated in our basic research program. Additional information on ARI or its programs can be obtained by contacting ARI's Web page (www-ari.army.mil) or the individual research unit chief listed at the end of each work package description.

Quality People

General Dennis J. Reimer, Chief of Staff of the Army, has said that "soldiers will always be the key to victory." For the Army to maintain full readiness with a smaller force and significantly reduced resources, it must ensure that the best people are recruited and that they are assigned to jobs for which they are most qualified. To retain the best soldiers, the Army must also provide support systems and career development opportunities that allow soldiers to "be all they can be" both in peacetime and in war. ARI's Quality People S&T program for FY98 includes four work packages that develop and use a variety of technologies to help maintain and enhance the quality of the Army.

I. 21st Century NCO (NCO21)

What are the attributes and skills that Noncommissioned Officers (NCOs) will require for the diverse, high technology missions of the future?

This work package began in FY97 and lays the groundwork for selecting, assigning, training, and promoting soldiers who will be effective NCOs for Force XXI and the AAN. The first step in this research is to understand how changing missions, force structure, and doctrine will affect the nature of NCO jobs, and thus, the characteristics of the individuals who must fill them. We will examine expected changes to NCO jobs in FY98. In FY99 we will develop new measures of individual characteristics that may be required by these changes. Products from this research will include detailed taxonomies and descriptions of the new NCO attributes needed to be effective in

the 21st Century. Future research will develop the selection/assignment criteria and performance measures to ensure that the highest quality soldiers will become our future NCOs.
(Dr. Michael Rumsey, DSN 767-8275)

II. Impacts of Military Experience on the Soldier (LIFELINE)

What are the impacts of major Army events and experiences, such as contingency operations, on recruitment, commitment, performance, readiness, and retention?

The objective of this work package is to use longitudinal, investigative methodologies to determine the effects over time of significant Army organizational changes and events on soldiers and their families. These methodologies have been used to determine the impact of events and deployments on such issues as family adaptation, training, readiness, and retention. To date, we have investigated the Gulf War, Army downsizing, and various

photo courtesy of Soldiers

stability operations such as the Sinai deployment of reserve forces and, most recently, Operation Joint Endeavor (OJE) in Bosnia. Results of our research have

improved mobilization procedures, skills assessment, pre-deployment training, and family support programs, to name just a few. In FY98, the final year of this work, we will provide the Army with early post-deployment lessons learned for the Reserve Component (RC) soldiers who participated in the OJE peacekeeping operation. This work focuses on both RC soldiers and their families, and the lessons learned include the effects of the deployment on training, readiness, leadership, family support, civilian jobs, and retention. In addition, this research will produce method-ological tools to evaluate the long-term effects of future significant military experiences on soldiers and their families. *(Dr. Paul Gade, DSN 767-8866)*

III. Soldier Attitudes and Opinions (TRENDS)

How can senior leaders accurately assess the command climate of the Army?

Senior leaders need to be able to accurately assess the command climate of the Army, to identify emerging soldier concerns, and to assess soldiers' reactions to the current Army environment and changes that occur both internally and externally. The objective of this work package is to develop and apply method-ologies to analyze and track the trends in soldier attitudes and opinions for use by senior Army leaders. Beginning in FY98, we will analyze and summarize Army and civilian data to provide insight on the Army's current command climate. Future products will include improved survey and research interview methodologies and the results of their application to the assessment of command climate and other attitude and opinion data over time. *(Dr. Alma Steinberg, DSN 767-0364)*

IV. Effective Special Forces and Small Unit Operations (TEAM-UP)

What are the methods for improving the performance of small, highly trained semi-autonomous units?

This work package will use Special Forces (SF) A-teams as the testbed for developing and testing strategies for improving performance of small, highly trained units. This research will transfer these successful strategies to other Army units to prepare them to perform more effectively in future operations that are

being developed in the AAN scenarios. In FY98 we will identify individual, team, and organizational factors that impact the effectiveness of SF A-team performance. Future research will develop and validate prototype interventions that improve significant problem areas identified in FY98. Future products will include improved methods for selecting SF soldiers, strategies to improve information flow within the chain of command, and improved leader and team training programs and strategies.
(Dr. Paul Gade, DSN 767-8866)

Leader Development

In FY98, ARI will be addressing leader development issues in its Basic Research (6.1)

program through University-based research projects. *(Dr. Michael Drillings, DSN 767-8641)*

Training

ARI's Training S&T program develops new training technologies and performance measurement techniques to train individual and unit tasks more effectively within budgetary constraints. Much of our research focuses on assessing and improving the effectiveness of new simulation technologies by developing strategies and programs to optimally employ these new technologies for training. The effectiveness of training simulations (live, virtual, or constructive) is largely a function of the methods used to apply them to the tasks they train, the adequacy of performance measurement, and the availability of timely and effective feedback. No matter how elaborate a simulation may be, it is a tool that is only valuable to the extent that it can ultimately improve soldier and unit performance. Special training issues often exist depending on the type of unit (light infantry, armor, aviation, etc.), on the component (Active, Reserve), or on the type of simulation technology. The 11 work packages for FY98, described below, address the overall design and/or evaluation of innovative training technologies, as well as many special training issues, to improve Army training effectiveness, efficiency, and readiness.

I. Structured Simulation-based Armor Training (STRONGARM)

What are the optimum methods for developing and using simulations, such as the Close Combat Tactical Trainer (CCTT), for training?

The objective of this work package is to develop, evaluate, and refine methods to enhance the training effectiveness of virtual simulations for collective training. Progress to date has included: (1) application and refinement of a method for assessing the training capabilities of simulations; (2) design, development, and evaluation of prototype structured simulation-based training programs; (3) assessment of a prototype performance feedback system; and (4) identification of lessons learned from developers and users of simulation-based training. The focus of this research has been on training for armored forces, and the lessons learned from our research are currently being applied to the CCTT (a network of computers providing realistic collective training for armor and mechanized infantry on a simulated battlefield). In FY98, the last year of this work, we will produce a thoroughly tested methodology for developing structured simulation-based training programs, and produce guidelines that can be distributed for applying the methods to other training simulations. These guidelines will include how to manage and sustain the quality of these innovative training programs.
(Dr. Barbara Black, DSN 464-3450)

II. Force XXI Training (FASTTRAIN)

How can the Army improve its unit training to effectively meet the challenges of the 21st Century?

This work package develops prototype training and performance evaluation techniques for both the conventional and the digital capabilities necessary for Force XXI. Our research will exploit the use of simulation (live, virtual, and constructive) to develop and demonstrate these prototype training and

evaluation techniques. Progress over the last two years includes the conduct of brigade and battalion pilots of three ARI-developed training packages: Force XXI Battle Staff Training System, Staff Group Trainer, and Brigade Staff Training Exercises. Three products will be delivered in FY98: (1) a prototype training package and associated performance measures for Force XXI training, (2) a front-end analysis of the requirements for using the CCTT to train in the digital mode, and (3) tools for assessing skill retention levels on selected digital tasks in the operation of the M1A2 tank. Future work will include refining and exporting the new training methods, packages, and strategies to use for training the Army's Force XXI.
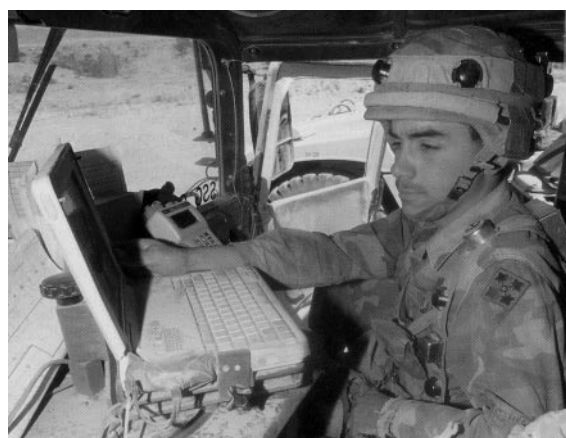*(Dr. Barbara Black, DSN 464-3450)*

photo courtesy of Soldiers

III. Night Operations Training Technologies (NIGHTFIGHTER)

What training concepts, methods, and technologies will improve the ability of the infantry to fight at night?

This research has identified night operations problems, possible training solutions to these problems, and validated training interventions applied to dismounted

infantry tasks for effective night fighting. We have also developed effective unaided night vision training, aiming light zeroing procedures, field expedient procedures for adjusting the visual acuity of night vision goggles, and a validated computer-based 2nd generation FLIR (forward looking infrared) combat vehicle identification program. In FY98 we will complete this work package by summarizing and documenting the training implications resulting from our thermal combat vehicle identification experiments; producing videos to capture the most effective night operation training techniques from our completed research; and completing a trend analysis of the operational and training problems related to night attack. *(Dr. Scott Graham, DSN 835-5589)*

IV. Technology-based Infantry Training (T-BIT)

How can new technology-based training packages assist infantry commanders to train their units in both live and simulated environments?

The objective of this new work package is to develop and evaluate prototype-training programs and simulation training support packages specifically related to infantry forces. Our research will investigate methods for effective design and implementation of technologies, such as distance learning, to support the Army's initiatives

in this area at the Infantry School. In FY98 we will develop and validate training materials for selected battle staff positions to include the infantry battle captain, and we will assess the utility and effectiveness of simulations and methods for training mounted and dismounted infantry units. We will also assess the small unit tactical requirements for Military Operations in Urban Terrain (MOUT). Future research will evaluate and refine training programs and performance measures for infantry battle staff training and for the dismounted infantry component in live and virtual combined arms simulation environments. *(Dr. Scott Graham, DSN 835-5589)*

V. Distributed Interactive Simulation (DIS) Training Technologies (SYNTRAIN)

What new training technologies can be used to enhance the effectiveness of Distributed Interactive Simulation (DIS) Systems?

The objective of this work package is to develop and demonstrate training, mission rehearsal, performance measurement, and feedback design technologies that take full advantage of DIS systems for improving Force XXI combined arms unit training. Products from previous years have included: the Unit Performance Assessment System (UPAS) to measure performance and provide training feedback in networked systems; and the Automated Training Analysis and Feedback System (ATAFS), an enhancement to UPAS which uses artificial intelligence technology to aid trainers in producing quality After Action Reviews (AARs). In FY98 we will complete this work by assessing the quality of AAR aids generated by ATAFS as a function of the training and experience of the trainer, and the type and complexity of the exercises being trained. We will also apply

cognitive modeling techniques toward producing more realistic behavior of computer-generated forces.
(Dr. Stephen Goldberg, DSN 970-3980)

VI. Virtual Environments for Combat Training (VIRTUE)

What are the required characteristics for using Virtual Environment (VE) systems for dismounted soldier training and rehearsal?

The development of Virtual Environment (VE) technologies offers an unparalleled

opportunity to provide effective training and rehearsal for soldiers to perform in the small-unit, quick-reaction scenarios envisioned in AAN. Our research to date has established a VE research facility, reviewed performance requirements, developed test scenarios and test batteries for assessing performance in VE, and demonstrated the effectiveness of VE for acquiring and transferring spatial knowledge to the "real world." In FY98 we will wrap up this work package by concentrating on how to use VE in collective small unit training. We will implement methods to measure team performance and assess the effect of measurement on training outcomes. The product of this effort will be findings and rec- ommendations to the equipment designers and the training community on how best to use VE technologies in training for small unit operations -- specifically, training dismounted infantry units. Since VE technologies are very new, we still have a number of unanswered

questions to be addressed in follow-on research, including: what types of tasks are best suited for training in VE; what levels of fidelity (imagery, sound, motion tracking, and touch) are required to produce cost-effective training systems; how do we minimize side- and after-effects of VE; and how do we maximize the transfer of VE training to performance in the real world?
(Dr. Stephen Goldberg, DSN 970-3980)

VII. Reserve Component Training Strategies (TRAIN-UP)

How can the Reserve Component (RC) improve training within time and resource constraints?

The goal of this work package is to help the RC train better, faster, and cheaper through the use of training aids, devices, simulators, and simulations (TADSS). TADSS can be used to assess proficiency levels of soldiers/crews and thereby determine which need remediation, how much they need, and on which tasks or missions. We have developed a TADSS-based tool for predicting gunnery qualification scores on M1A2 Tank Table VIII (the crew-level, live-fire certifica- tion exercise), as well as a competency-based strategy for training tank gunnery using two simulators: the Conduct-of-Fire Trainer (COFT) and the Abrams Full-Crew Interactive Simulation Trainer (AFIST). In FY98, the final year of this work, we will develop a generic software tool for RC units to predict live-fire performance (e.g., tank gunnery quali- fication, M16A2 rifle marksmanship qualifica- tion) based on performance in simulators, and show how live-fire tank gunnery qualification scores can be predicted from a smaller subset of firing engagements than are currently fired for Table VIII. In addition, we will complete

an assessment of the Armor and Mechanized Infantry time-compressed gunnery training strategy developed by the National Guard Bureau and the Defense Advanced Research Project Agency under Project SIMITAR (Simulations in Training for Advanced Readiness). Follow-on work will include applying these tools and strategies to other weapon systems and simulations. *(Dr. Ruth Phelps, [208] 334-9390)*

VIII. Simulation Training for Aviation (STRATA-FI)

What are the simulation fidelity requirements and the appropriate mix of simulation and aircraft for cost-effective aviation training?

This work package focuses on determining the simulator capabilities and tradeoffs required to train basic and advanced aircrew skills using proficiency-based instruction. Using ARI's state-of-the-art aviation training research simulator (STRATA), design issues have been addressed to determine their relative contributions to skill acquisition and retention for rotary wing aviation tasks. Experiments have been performed to assess the degree to which simulator design features affect transfer of training to actual aircraft flight performance. To date, we have determined helicopter simulator fidelity requirements for

photo courtesy of <u>Weapon Systems</u>

crew and multi-aircraft task training for a variety of rotary wing aircraft types. In FY98 we will complete this work by developing a set of specifications for future flight simulators which will include the types and directions of motion which they must generate to train effectively for Force XXI. We will also provide recommendations for the most effective mix of simulators and aircraft for maximizing the efficiency and effectiveness of Initial Entry Rotary Wing training. *(Dr. Dennis Wightman, DSN 558-2834)*

IX. Battle Command Training (DECIDE)

How can the Army prepare battle commanders to handle the requirements of the digitized battlefield?

This new work package will develop and demonstrate stand-alone, self-paced instruction to improve the cognitive thinking skills needed to perform battle command tasks more effectively in the complex and volatile environment anticipated during the early part of the 21st Century. This program of instruction will supplement standard practices of battle commander development which focus on the acquisition of knowledge and procedures. During FY98 we will develop measures of battle command skills that will be used to assess both leader performance -- is battle command training and development being translated into effective leader behavior and improved decision making?-- and program effectiveness -- are we improving adaptive thinking skills? Future products will include validated training materials for teaching versatile thinking in battle command scenarios and "lessons learned" resulting from actually teaching cognitive skill enrichment to future battle commanders. *(Dr. Stan Halpin, DSN 552-9758)*

X. Joint Operations Simulations (JOSHUA)

How can the Army assess its training effectiveness and readiness for the joint operating environment of Force XXI and AAN?

The objective of this work package is to develop and test new training and evaluation methods for use in distributed synthetic environments to effectively train Joint Mission Essential Tasks (JMET). We have developed distributed training techniques and metrics for evaluating complex, multi-echelon Joint Staff exercises — specifically, planning joint targeting for the joint fire support mission. In FY98 we will develop and demonstrate improved methods for writing training objectives and translating them into efficient exercises for fire support training in joint environments. We will also develop the methods for measuring complex organizational performance. Future work will assess how well simulations and models work to achieve effective training of JMET. Methods will be developed for planning and conducting systematic, vertical (multi-site, multi-service, and multi-echelon) training feedback, and for linking exercise performance to estimates of training effectiveness and readiness.
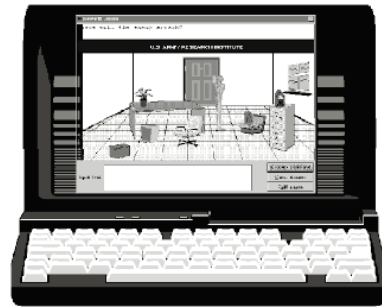*(Dr. Robert Seidel, DSN 767-8838)*

XI. Foreign Language Tutor (SIMTALK)

What advanced tutoring features are effective for sustaining perishable language skills and how can such features be easily incorporated into effective tutoring programs?

The objective of this new work package is to develop a set of computer-based tutoring techniques to sustain perishable foreign language skills and be easily modifiable to support rapidly changing training requirements. For example, one technique immerses users in simulated task environments in which they can engage in virtual dialogues with computer-generated images representing indigenous people in host countries. The final product will be a computer-based tutor and authoring system that is easy to use to develop language skill training and su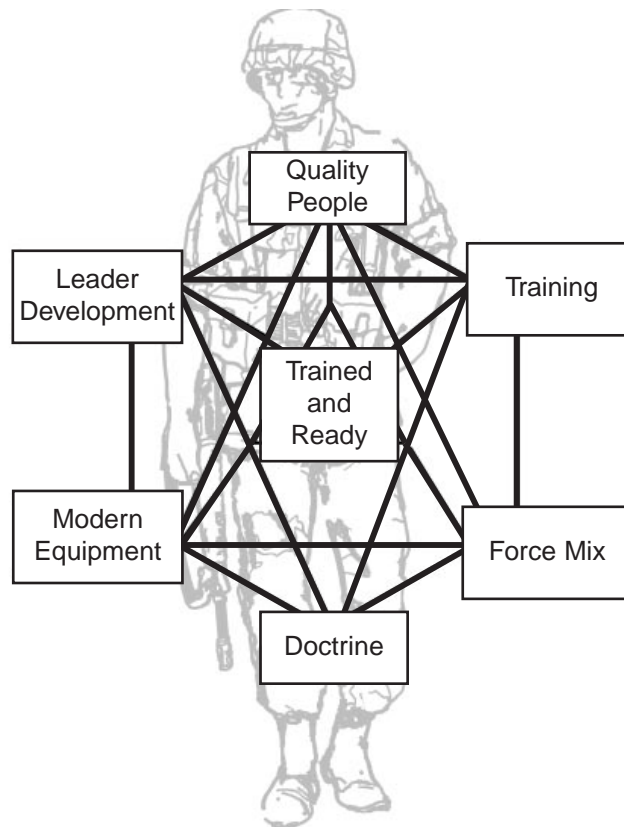stainment programs. It will incorporate natural language processing and continuous speech recognition (CSR) to control video and animated graphics in mission

simulations. In FY98 the interim discrete speech recognition version of the language tutor and authoring system will be evaluated by the Special Operations Forces, and the CSR system will be developed.
(Dr. Robert Seidel, DSN 767-8838)

ARI has a highly trained and experienced staff, which is able to quickly understand Army challenges and provide technologies to help meet them. Most of our scientific staff have Ph.D. level training in a recognized field of social or behavioral science and have at least 20 years of research experience working on Army issues. In 1996, ARI received the American Psychological Association's Presidential Award recognizing our "enormous contributions to the behavioral and social sciences."

ARI research primarily supports initiatives of the Deputy Chief of Staff for Personnel, the Commanding General, Training and Doctrine Command, and the Chief of Staff, Army. The goal of our S&T program is to provide high quality personnel performance and training research to ensure a trained and ready Army.

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For additional information about this document, contact the ARI Plans and Programs Office, (703) 617-8642 or DSN 767-8642

14. ABSTRACT (Maximum 200 words)

     The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is the Army's primary laboratory and developing agency for personnel performance and training (PPT) science and technology (S&T). This document represents ARI's FY98 applied research (6.2) and advanced technology development (6.3) programs. It describes each of ARI's 15 work packages and discusses how they support the future Army: near-term (FORCE XXI) and the Army envisioned for 2025 (Army After Next). ARI's mission is to provide the technologies that will improve the entire life cycle of the soldier. ARI's S&T program supports the Army's imperatives and is focused on quality people, leader development and training research required to ensure a trained and ready Army. This document also presents an overview of ARI, and where to find additional information.

15. SUBJECT TERMS
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16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	19. LIMITATION OF ABSTRACT Unclassified	20. NUMBER OF PAGES 16	21. RESPONSIBLE PERSON (Name and Telephone Number) Dr. Frank Moses (703)617-5948